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Positive impacts of COVID-19 Lock down in Bangladesh: An online investigation

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ABSTRACT

Background: This research focuses on the positive impacts of the COVID-19 lockdown on society and the environment, despite acknowledging the widespread negative effects of the pandemic and lockdown measures. The research was aimed at pinpointing and evaluating the beneficial results stemming from these measures.

Method: Data for the study was collected through an online survey distributed via Google forms to adults over the age of 18 across the country. A total of 1230 participants completed the survey, mostly from rural areas (61.7%), providing valuable insights for analysis. The questionnaire encompassed personal, family, and cohesive social data, along with information on the environment and biodiversity. The study utilized structural equation modeling (SEM) and confirmatory factor analysis (CFA) to analyze the data and examine correlations between variables.

Results: The findings indicated that the COVID-19 lockdown had positive implications for individuals and society, leading to increased health consciousness, improved family relationships, and constructive social attitudes. Moreover, restrictions on access to natural tourist destinations and parks during the lockdown contributed to positive changes in biodiversity. These results highlight the importance of adopting appropriate measures during pandemics to foster personal and social well-being, as well as the preservation of natural environments and biodiversity.

Conclusion: This study emphasizes the need for further research to promote sustainable living in similar situations. By understanding the data appropriately, individuals can play a constructive role in future pandemics, leading to positive outcomes for both society and the environment.

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Introduction

Originating in Wuhan, China in 2019, COVID-19 swiftly transformed from a localized health concern into a substantial global public health issue, eventually culminating in a pandemic that spread across the world [1]. On March 8, 2020, Bangladesh's Institute of Epidemiology, Disease Control, and Research (IEDCR) announced the first three confirmed COVID-19 cases [2]. Coronavirus was a one-of-a-kind virus that knew no boundaries, religions, or cultures, infecting people from all walks of life. Bangladesh, as a third-world country with millions living in poverty, faced several challenges. Despite the rapid spread of COVID-19, which risked lives and hurt the nation's finances, some significant societal benefits emerged. The spread of coronavirus made people more health-conscious than ever before, leading to healthier lifestyles. Shops, restaurants, and public spaces became cleaner than ever. Following the pandemic's onset, there was a noticeable increase in public awareness concerning the significance of handwashing. Governments around the world enforced quarantine restrictions, confining populations to their homes. In Bangladesh, the lockdown and quarantine measures prompted a significant reduction in economic activities and transportation, which subsequently led to decreased noise levels across the country. The temporary cessation of travel resulted in quieter oceans, relieving the pressure on marine life [1].

The extended lockdown and social distancing provided an opportunity for the planet and wildlife to thrive in their natural environment. With reduced human activity, lands across the world flourished, and biodiversity improved. Nature began to restore its balance, especially with the closure of tourism and resorts during the COVID-19 lockdown. Furthermore, the drastic reduction of industrial activities during the lockdown almost stopped the tremendous environmental pollution caused by these industries. Amidst the distress and despondency that surrounded the COVID-19 outbreak, certain positive outcomes became evident. The pandemic underscored the significance of achieving a balance between economic development and environmental conservation, leading to a reevaluation of our impact on the planet.

Previously, COVID-19 posed a global concern, compelling people across the world, including Bangladesh, to turn to religious rituals for solace. The pandemic sparked a heightened sense of shared humanity, fostering deeper bonds of affection among individuals. The lockdown measures compelled people to stay and work from home, fostering stronger family bonds. This arrangement allowed for better sleep and improved productivity, as commuting time was saved. Additionally, the lockdown instigated a feeling of generosity and cooperation, with individuals extending help through free food, medical care, and supplies. Despite the positive aspects, the lockdown also led to increased domestic violence. However, some couples volunteered to share household duties, displaying a sense of mutual support. As anthropogenic activities halted due to the lockdown, there was a reduction in pollutants and enhanced air quality. Reports indicated significant decreases in N2O and carbon emissions in other countries during the lockdown. Reductions in human travel, air travel, and tourism contributed to a 7% drop in carbon emissions globally, a record since World War II [3]. The pandemic also brought about a reduction in plastic and polythene usage at home, contributing to lowered pollution levels. With restricted human activities, the environment began to heal, and pollution levels in the air, water, and ecosystems started to decline. Satellite data confirmed lower nitrogen dioxide levels in the air, attributed to COVID-19's impact on human activity [4]. Moreover, the decline in fishing activity during the lockdown had a positive impact on marine fisheries.

In the past, domestic production witnessed an increase due to family or cottage-level agricultural practices and other small-scale handicraft productions in society. During the lockdown, many individuals utilized their ample free time to engage in rooftop or veranda gardening, meeting daily vegetable demands and contributing to environmental preservation by increasing oxygen supply through greening. The pandemic crisis had the potential to stimulate innovation among people, leading to the introduction of more effective and productive primary and secondary items, efficient production methods, technological advancements, and cost-effective productions. With increased leisure time, online businesses and freelancing became popular, benefiting future generations and reducing unemployment rates. Numerous volunteer organizations emerged to assist those impacted by COVID-19, particularly those facing income loss due to the lockdown. The spread of COVID-19 provided a unique opportunity for large-scale social experimentation. Natural experiments play a vital role in understanding causal relationships in research on various topics, and COVID-19 presented such an opportunity. The lockdown imposed by the pandemic in Dhaka yielded substantial enhancements in air quality. This improvement stemmed from restricted vehicular movement, the cessation of brick kiln operations, and factory closures that collectively contributed to lowered pollution levels. Nevertheless, as far as our knowledge extends, prior investigations have not delved into the favorable effects of the COVID-19 lockdown in Bangladesh. Furthermore, no preceding COVID-19 related research conducted within the country has harnessed the analytical power of structural equation modeling (SEM) and confirmatory factor analysis (CFA). Hence, this study was conducted to investigate the potential positive impacts of the COVID-19 lockdown in Bangladesh using SEM and CFA. These methodologies allowed for modeling a network of complex underlying relationships between measurement items and influencing factors, shedding light on the lesser-explored aspects of the lockdown's effects on society and the environment.

Materials and methods

Study data

Data was gathered through an online survey that distributed questionnaires in the form of Google forms to adults over the age of 18 across the country. Questionnaires were used as the primary data collection tool, and they were distributed online to estimate the positive impacts of COVID-19's lockdown on various aspects, propose various research hypotheses, test the hypotheses using a structural equation model, and predict the outcome using a test confirmatory factor. A systematic questionnaire was sent to a large number of male and female participants from around the country. The survey garnered responses from a total of 1230 individuals, who

actively participated and returned the survey for further analysis. This number appears to surpass the minimum requirement for research of this kind, which typically necessitates a minimum of 150 engaged participants. When utilizing structural equation modeling, a total of 150 is appropriate for measuring less than seven constructs and modest commonalities [5]. The target population of this study wasn't the people who were infected with COVID-19. Rather, the target population was the people who were in lockdown. Five participants should be the minimum for each study variable; nonetheless, the 10:1 ratio is the most appropriate manner to draw a conclusion (10 samples for one variable) [5]. Another study put forward a comparable recommendation, proposing that a minimum of 10 participants be allocated for each parameter [6]. Roscoe presented several general guidelines in a different way, such as the preference for sample sizes bigger than 30 and lower than 500 [7], and the advice that, in multivariate research, the sample size should be at least 10 times (ideally more) as large as the number of variables [8].

Ethical clearance

Ethical clearance for this study was given by Center for Multidisciplinary Research, Gono Bishwabidyalay (Gono University), Bangladesh (Registration Number: CMR/E C/004), dated June 9th, 2021.

Study questionnaire

The questionnaire was split into two parts, the first of which focused on the socio-demographic characteristics of the respondents. The study participants' thoughts on COVID-19 lockdown's positive effects on social, environmental, and other elements, in general, were obtained using a 5-point Likert scale, which was essentially brought down to a 3-point Likert scale for analytic and simplification purposes, with a total of 38 questions [Table-1]. The validity and reliability of the scales were tested. The 3-point Likert scale was used in this research for several reasons. Firstly, the scale's simplicity and clear response options facilitated easy comprehension for the respondents, contributing to a potentially higher response rate and reduced respondent burden [9]. Additionally, the 3-point scale proved to be time-efficient [10], benefiting both the participants and researchers during data collection. Given the focus on positive

Table-1
38 items of the questionnaire.

Questionnaire items
1. Did the lockdown lead to an increase in family bonds?
2. Were measures implemented during the lockdown effective in controlling the population increase?
3. Did the lockdown result in a surge of online businesses?
4. Were online classes and exams introduced during the lockdown?
5. Did the lockdown lead to increased efficiency through online training/programs?
6. Was the internet utilized productively during the lockdown?
7. Did graduate/postgraduate students engage in more research during the lockdown?
8. Did the lockdown influence changes in individual attitudes?
9. Did the lockdown foster increased creativity among individuals?
10. Did the lockdown encourage the exploration of new sources of income?
11. Did the lockdown contribute to protection from other infectious diseases?
12. Did the lockdown lead to a decrease in tree cutting compared to previous levels?
13. Was there a reduction in environmental pollution during the lockdown?
14. Was there a decrease in the use of public transport during the lockdown?
15. Did the lockdown result in a decrease in air pollution?
16. Did the lockdown promote efforts for nature conservation?
17. Were wildlife protection measures strengthened during the lockdown?
18. Was there a positive impact on biodiversity conservation during the lockdown?
19. Did individuals exhibit increased patience over the course of the lockdown?
20. Was there a decrease in environmental pollution at tourist centers during the lockdown?
21. Was there a reduction in the production of unhealthy food during the lockdown?
22. Did the lockdown lead to increased consumption of homemade food?
23. Did the lockdown foster an increase in humanity among individuals?
24. Did human sympathy grow during the lockdown?
25. Did the fear of dying increase during the lockdown?
26. Was there an increase in frugality among individuals over the course of the lockdown?
27. Was sustainable development of resources considered achievable during the lockdown?
28. Was there a reduction in the misuse of resources during the lockdown?
29. Did religious practices increase during the lockdown?
30. Was there a decrease in illegal activities during the lockdown?
31. Was the circulation of illegal drugs reduced during the lockdown?
32. Did individuals consume fewer illegal drugs during the lockdown?
33. Was there a decrease in the import/export of illegal products during the lockdown?
34. Was there a decrease in accidents during the lockdown?
35. Was there an increase in demand for everyday products during the lockdown?
36. Were everyday products easily available during the lockdown?
37. Did individuals become more self-conscious during the lockdown?
38. Did COVID consciousness help in protecting individuals during the lockdown?

impacts of the COVID-19 lockdown in the abstract, this scale effectively captured basic attitudes or opinions related to the studied factors without overwhelming the participants with an extensive range of response options [11]. Moreover, aligning with the research goals of assessing general attitudes or perceptions rather than requiring intricate distinctions, the 3-point Likert scale offered a suitable measurement approach [12]. Finally, the decision to use a shorter scale have been influenced by resource constraints, as it allowed for streamlined data collection within the limitations of time and budget.

Expert opinion was solicited to see if the questions were suitable for measuring the targeted study questions and if the statements were comprehensible. As a result of the feedback from the experts, the scale was altered. Despite the fact that a considerable number of respondents were contacted, the study group comprised of 1230 people who completed the online survey. Questionnaires designed using Google Forms were distributed to individuals aged 18 and above across the nation through diverse channels such as Facebook, Email, WhatsApp, and various social media platforms. The survey remained accessible on the internet for a span of eight weeks, spanning from July 1 to September 30. During this interval, participants engaged with the research questions and provided comprehensive responses, thereby furnishing substantial evidence that underscores the favorable repercussions of the COVID-19 lockdown on a range of societal and environmental dimensions. The data collected via the online survey provided valuable insights into the multifaceted effects of the lockdown measures, confirming the relevance and significance of the research questions explored in this study. The association between factors and factor loads was then evaluated using confirmatory and explanatory analyses. Cronbach's alpha values for each of the scales and their subfactors were determined for the reliability and validity investigation. Item factor loads ranged from 0.507 to 0.931, according to the data gathered for the explanatory factor analysis. All variables had a Cronbach's alpha reliability coefficient of 0.929. The tables provided later contain Cronbach's alpha values for each factor, item factor loadings, and goodness of fit indices based on the confirmatory factor analysis results. Table 3 outlines the participants' demographic profile, including age, gender, educational level, occupation, marital status, family type, and income. As seen in Table 3, males made up 60.5% of the respondents, while females made up 39.5%.

Statistical analyses

Structural equation modeling (SEM) and confirmatory factor analysis (CFA) were utilized in the analysis of data and the examination of correlations between variables in this study. IBM SPSS, a statistical data analysis software, and AMOS, a software capable of conducting structural equation modeling, were employed for the execution of SEM and CFA. For SEM and CFA, AMOS was used. For Exploratory Factor Analysis, required prior to CFA, IBM SPSS was used. In a nutshell, structural equation modeling is a set of multivariate statistical methods for modeling a network of the complicated underlying relationship between one or more measurement items and influencing factors. SEM and CFA are two very powerful tools for finding the underlying structure of study variables considering the factor relationships after finding the exploratory part of the variable structure. These help in studying the inner complex mechanism of how the study variables are factored and correlated to each other with the variables affecting the same hypothesis being analyzed for their latent structural connections. Confirmatory factor analysis (CFA) is a technique for confirming the factor structure of a set of variables [13]. The proposed equation model to suggest the positive impact of the COVID-19 lockdown in this pandemic situation was created using eight latent variables, six of which were discovered in the total variance explained encountered during the exploratory factor analysis phase, and the amount of variance observed by the model was 76.8%, which is a sizable portion of the total variability. Environmental development, resource sustainability, illegal activity reduction, consciousness, educational improvement, and humanitarian activities were among the variables discovered by exploratory factor analysis, which were classified into six factors in the model: ENV, RES, ILL, CON, EDU, and HUM. There were 19 variables assigned to these categories and explained the overall variability of these factors. All of the observed variables were hypothesized to have a substantial positive

Table 2
Factors and variables of the model.

Factors	Items	Variable descriptions
RES	res2	Sustainable development of resources being possible
	res1	Misuse of resources lessen
HUM	hum2	Humanity increasing
	hum1	Human sympathy is growing
EDU	edu2	Graduate/Post graduate students doing more research
	edu1	Your creativity flourished
CON	con2	COVID-19 consciousness helps protecting it
	con1	Being more conscious of yourself
ILL	ill4	Illegal products being less imported/exported
	ill2	Illegal drugs circulation lessens
	ill3	People taking fewer illegal drugs
ENV	env8	Less use of public transport
	env1	Trees cut down less than before
	env7	Environmental pollution of tourist centers decreasing
	env2	Less environmental pollution
	env5	Wildlife being more protected
	env6	Biodiversity being conserved
	env4	Increasing nature conservation
	env3	Air pollution decreasing

Table 3
Socio-demographic characteristics of the respondents.

	Frequency (n = 1230)	Percentage
Age Group		
15–24 years	531	43.2
25–34 years	647	52.6
35–44 years	39	3.2
45+ years	13	1.1
Gender		
Male	744	60.5
Female	486	39.5
Present Living Area		
Urban	471	38.3
Rural	759	61.7
Highest Education		
Primary	5	.4
Secondary	21	1.7
Higher secondary	110	8.9
Graduate	655	53.3
Post graduate	438	35.6
Marital Status		
Unmarried	952	77.4
Married	268	21.8
Divorced	10	.8
Occupation		
Unemployed	139	11.3
Student	707	57.5
Government job	121	9.8
Private job/service	203	16.5
Businessman	30	2.4
Housewife	30	2.4
Monthly Family Income		
<15000 BDT	204	16.6
15000–30000 BDT	368	29.9
>30000 BDT	658	53.5
Family Type		
Nuclear	938	76.3
Joint	292	23.7

impact on the latent variables which are to be checked by the related path coefficients. These observed variables are listed in Table 2 under these latent variables.

Several model fit indices such as, the χ^2/df (chi-square/degree of freedom), Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), Normed Fit Index (NFI), Relative Fit Index (RFI), Rot Mean Square Residual (RMR), Tucker Lewis index (TLI), Parsimony-Adjusted Measures Index (PNFI), Parsimony Ratio (PRATIO), and Incremental Fit Index (IFI) were examined to check the felicitousness of the solution and goodness-of-fit of the model.

Environmental development

Amidst the numerous negative impacts of the COVID-19-imposed lockdown, there was a noticeable and substantial positive influence on the environment in nearly every country worldwide. With human activities coming to a halt, nature was able to heal and thrive, reflecting a significant improvement in environmental conditions. Lockdown aided in reducing global climate change, resulting in a favorable impact on the environment and an improvement in biodiversity [14]. Air and water quality in India improved during this time, highlighting the underutilization of public transportation [15]. Preserving environmental improvements resulting from reduced industrial activity and traffic limitations while lockdown [16]. While the lockdown had a negative impact on the tourism industry, it had a favorable impact on the environment [17]. This study investigated various environmental issues and examined whether the COVID-19 lockdown period had a positive impact on the environment.

Hypothesis 1 (H1). COVID-19 lockdown positively benefits environmental development and improvement as fewer trees were cut down than before.

Hypothesis 2 (H2). The lockdown resulted in a positive impact on the environment because there was less environmental pollution.

Hypothesis 3 (H3). The lockdown period had a positive impact on the reduction in air pollution.

Hypothesis 4 (H4). The lockdown due to COVID-19 had a positive impact on the increase in natural conservation.

Hypothesis 5 (H5). The lockdown had a favorable impact on wildlife protection.

Hypothesis 6 (H6). The COVID-19 lockdown had a positive impact on biodiversity conservation.

Hypothesis 7 (H7). The lockdown had a positive effect on the decreasing environmental pollution of tourist centers.

Hypothesis 8 (H8). The lockdown period positively impacted the use of public transport.

Resource sustainability

According to Rubino et al., the time of COVID-19 witnessed the emergence of sustainability of resources as a notable phenomenon, despite the numerous negative impacts linked to the pandemic [18]. The enhancement of robustness and reusability yielded a positive influence on the socioeconomic aspects of sustainability [19]. Remarkably, the period of the COVID-19 lockdown brought attention to the concern of resource mismanagement. In the midst of the challenges brought about by the pandemic, individuals displayed an elevated consciousness and conscientiousness in their utilization of resources. Studies revealed that both medical and everyday household resources were used more judiciously during this period, leading to a decrease in their misuse [20,21]. This research aimed to investigate the possibility of achieving sustainable development of resources and reducing resource misuse through the implementation of the lockdown measures.

Hypothesis 9 (H9). The lockdown positively affected the misuse of resources.

Hypothesis 10 (H10). There was a positive impact of lockdown on sustainable development of resources.

Illegal activity reduction

During the global lockdown imposed amid the coronavirus spread, international trade and the movement of products across borders came to a near standstill. Despite the pandemic's negative repercussions, a positive effect was seen in illegal drug activities due to lockdown restrictions. EMCDDA's reports noted decreased drug circulation and usage during the first months of COVID-19 lockdown in Europe [22], especially impacting cocaine and MDMA due to market closures. Moreover, illegal drug seizures increased during the pandemic [23]. A study in Germany found that during COVID-19, over half of the participants in their study voluntarily reduced or completely stopped using illegal drugs [24]. This study aimed to explore the relationship between the lockdown conditions and the reduction in illegal activities, drug circulation, and consumption.

Hypothesis 11 (H11). The lockdown impacted positively in less circulation of illegal drugs.

Hypothesis 12 (H12). The COVID-19 lockdown impacted positively in less consumption of illegal drugs.

Hypothesis 13 (H13). The lockdown during the pandemic impacted positively in less import/export of illegal products.

Consciousness

In spite of the challenges and negative impacts imposed by the COVID-19 pandemic, a positive outcome was observed through increased self-consciousness and COVID-19 awareness. These factors not only succeeded in preventing the spread of the coronavirus but also contributed to curbing the transmission of other diseases. Heightened consciousness of the pandemic played a crucial role in reducing the COVID-19 outbreak [25]. Similarly, the benefits of pandemic awareness in safeguarding individuals from infection and speculated that future infectious diseases might not spread as easily as the coronavirus due to increased consciousness [26]. The pandemic might have positively influenced individuals' health and self-awareness [27].

Hypothesis 14 (H14). The COVID-19 lockdown impacted positively on one being more conscious of oneself.

Hypothesis 15 (H15). The lockdown had a positive impact on COVID-19 consciousness that helps protect from it.

Educational improvement

While the COVID-19 pandemic inflicted substantial damage on the education sector globally by necessitating the closure of educational institutions, certain regions exhibited glimpses of potential improvements. Despite the severe impact on education, some areas displayed positive changes during this time. Several research studies have been conducted, highlighting the harsh impact of the COVID-19 lockdown on the formal education sector, which undoubtedly suffered significantly during the pandemic. However, this study focused solely on the few positive aspects observed in the education sector, particularly beyond formal education, with the aim of highlighting some positivity amidst acknowledging the negative impacts [28,29]. Positive effects of COVID-19 on the education sector have been identified, including the adoption of blended learning approaches, development of Learning Management Systems, Open and Distant Learning (ODL) initiatives, and increased collaborative work worldwide [28,29]. Additionally, individual creativity flourished during the pandemic [30]. With more time at home, many people engaged in trying new activities and learning innovative skills in their spare time. University students, in particular, utilized the extra time during the epidemic to conduct numerous research projects on various topics, exploring the diverse effects of the COVID-19 pandemic [31,32]. These collaborative efforts among national and international academicians led to a considerable amount of research by university students, contributing to a silver lining amidst the cloud of negative impacts.

Hypothesis 16 (H16). The COVID-19 lockdown impacted positively one's creativity being flourished.

Hypothesis 17 (H17). The lockdown had a positive impact on graduate/postgraduate student's research work.

Humanitarian activities

The COVID-19 pandemic presented an unprecedented calamity, inflicting significant hardship on humanity and causing profound distress [33]. However, amidst these challenges and the overwhelmingly negative impact of the virus, a positive effect was observed as empathy for humanity grew during this time period. Empathy grew alongside self-awareness and COVID-19 consciousness, reflecting human compassion's resilience and potential for positive change amid challenges. Studies noted increased humanitarian actions during the COVID-19 lockdown [33]. Amid the pandemic, research highlighted growing empathy among people [34], investigating the lockdown's role in fostering humanitarian effort and empathy.

Hypothesis 18 (H18). The COVID-19 lockdown crisis impacted positively on growing human sympathy.

Hypothesis 19 (H19). The lockdown situation had a positive impact on increasing humanity.

Results analysis

The descriptive analysis of the socio-demographic characteristics of the respondents in Table 3 shows that most of the respondents belonged to 15–24 years (43.2%) and 25–34 years (52.6%) age groups, were male (60.5%), were living in rural areas (61.7%), graduate (53.3%), and unmarried (77.4%). A large chunk of the respondents were students (57.5%), lived in a nuclear family (76.3%), and had a monthly family income of more than 30,000 BDT (53.5%).

The fitted structural equation model for this investigation demonstrated an excellent fit, as evidenced by all fit indices falling within acceptable limits (see Table 4). Fig. 1 depicts the unstandardized path coefficients of the structural model, while Table 5 presents the path coefficients of the observed variables in the unstandardized model. The study's findings revealed that all critical region values or t-values surpassed the required threshold of 1.96, and the corresponding p-values indicated high significance. These p-values signify the significance of the path coefficients in the Confirmatory Factor Analysis (CFA), representing the relationships between latent variables and their respective factors. Notably, the obtained p-values (<0.0001) suggested that the null hypothesis, assuming independence or no relation between latent variables and factors, may not be supported.

The standardized estimates of the path coefficients are shown in Fig. 2 with Table 6 presenting the respective estimates of the path coefficients, standard errors, critical values or t-values with significance indication. Table 6 provides a detailed breakdown of the observed variables that were found to have a positive and highly significant relationship with the Environmental development factor (ENV), as hypothesized in this study. These variables include less use of public transport (env8), reduced tree cutting (env1), decreased environmental pollution in tourist centers (env7), diminished overall environmental pollution (env2), increased wildlife protection (env5), enhanced biodiversity conservation (env6), amplified nature conservation efforts (env4), and reduced air pollution (env3). The estimated path coefficients for these relationships were 0.799 (for H3), 0.873 (for H4), 0.884 (for H6), 0.848 (for H5), 0.739 (for H2), 0.616 (for H7), 0.630 (for H1), and 0.556 (for H8), aligning with the hypotheses posited in this study.

The decline in illegal activity (ILL) exhibited robust and statistically significant correlations with several factors: reduced import/export of illegal products (ill4), diminished circulation of illegal drugs (ill2), and decreased consumption of illegal drugs by individuals (ill3), yielding respective path coefficient estimates of 0.878 (for H12), 0.858 (for H11), and 0.700 (for H13). In a similar vein, the latent variable Consciousness (CON) displayed a positive relationship with heightened COVID-19 consciousness (con2) and increased self-awareness (con1), yielding path coefficient estimates of 0.816 (for H14) and 0.472 (for H15) respectively, both of which exhibited high significance based on the p-values. A parallel pattern emerged for the latent variable educational improvement (EDU), with observed variables reflecting enhanced creativity (edu1) and increased research by graduate/postgraduate students (edu2) positively and significantly correlated, yielding path coefficient estimates of 0.722 (for H16) and 0.550 (for H17) respectively. The latent variable humanitarian activities (HUM), composed of underlying observed variables representing increased humanity (hum2) and growing human sympathy (hum1), displayed strong and highly significant positive relationships with HUM, yielding path coefficient estimates

Table 4
Model fit indices measurement for the model.

Indices	Perfect fit	Acceptable fit	Model fit
GFI	$0.95 < GFI < 1$	$0.90 < GFI < 0.95$	0.923
AGFI	$0.90 < AGFI < 1$	$0.85 < AGFI < 0.90$	0.893
RMR	$0 < RMR < 0.1$	$0 < RMR < 0.1$	0.024
RMSEA	$0 < RMSEA < 0.1$	$0.05 < RMSEA < 0.08$	0.067
CFI	$0.97 < CFI < 1$	$0.95 < CFI < 0.97$	0.941
PRATIO	$0.9 < PRATIO < 1$	$0.8 < PRATIO < 0.9$	0.801
PNFI	$PNFI > 0.5$	$PNFI > 0.5$	0.746
IFI	$0.95 < IFI < 1$	$0.90 < IFI < 0.95$	0.941
TLI	$0.90 < TLI < 1$	$0.90 < TLI < 0.95$	0.926
NFI	$0.90 < NFI < 1$	$0.90 < NFI < 0.95$	0.931
RFI	$0.90 < RFI < 1$	$0.90 < RFI < 0.95$	0.914
χ^2/df	$\chi^2/df < 3$	$3 < \chi^2/df < 5$	3.475

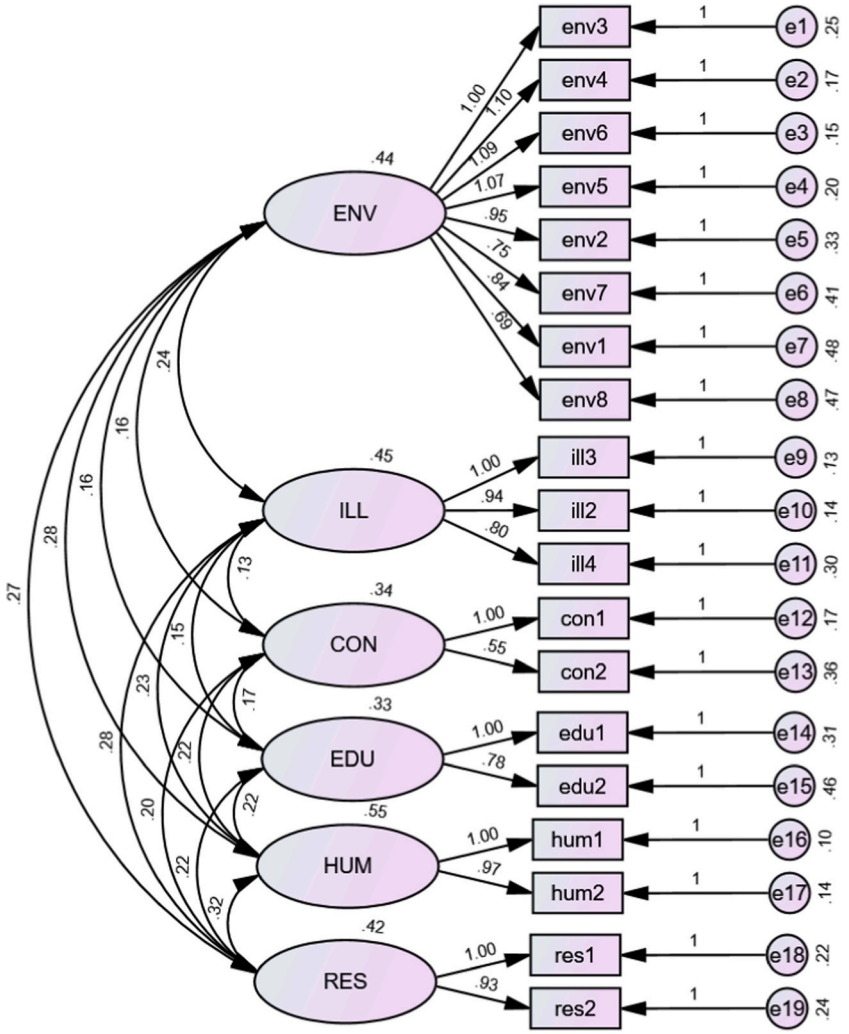

Fig. 1. Structural model: unstandardized path coefficients of the latent variables.

Table 5
Confirmatory factor analysis unstandardized estimates of path coefficients.

Variables	Path of coefficients	Latent variables	Path coefficients	S.E.	Critical region	*p*-value
env3	<—	ENV	1.000			
env4	<—	ENV	1.098	.031	35.722	<0.0001
env6	<—	ENV	1.092	.030	36.335	<0.0001
env5	<—	ENV	1.071	.031	34.289	<0.0001
env2	<—	ENV	.953	.033	28.507	<0.0001
env7	<—	ENV	.755	.033	22.760	<0.0001
env1	<—	ENV	.844	.036	23.404	<0.0001
env8	<—	ENV	.692	.034	20.186	<0.0001
ill3	<—	ILL	1.000			
ill2	<—	ILL	.937	.028	33.876	<0.0001
ill4	<—	ILL	.801	.030	26.877	<0.0001
con1	<—	CON	1.000			
con2	<—	CON	.548	.055	10.037	<0.0001
edu1	<—	EDU	1.000			
edu2	<—	EDU	.778	.066	11.865	<0.0001
hum1	<—	HUM	1.000			
hum2	<—	HUM	.971	.027	36.307	<0.0001
res1	<—	RES	1.000			
res2	<—	RES	.926	.037	25.337	<0.0001

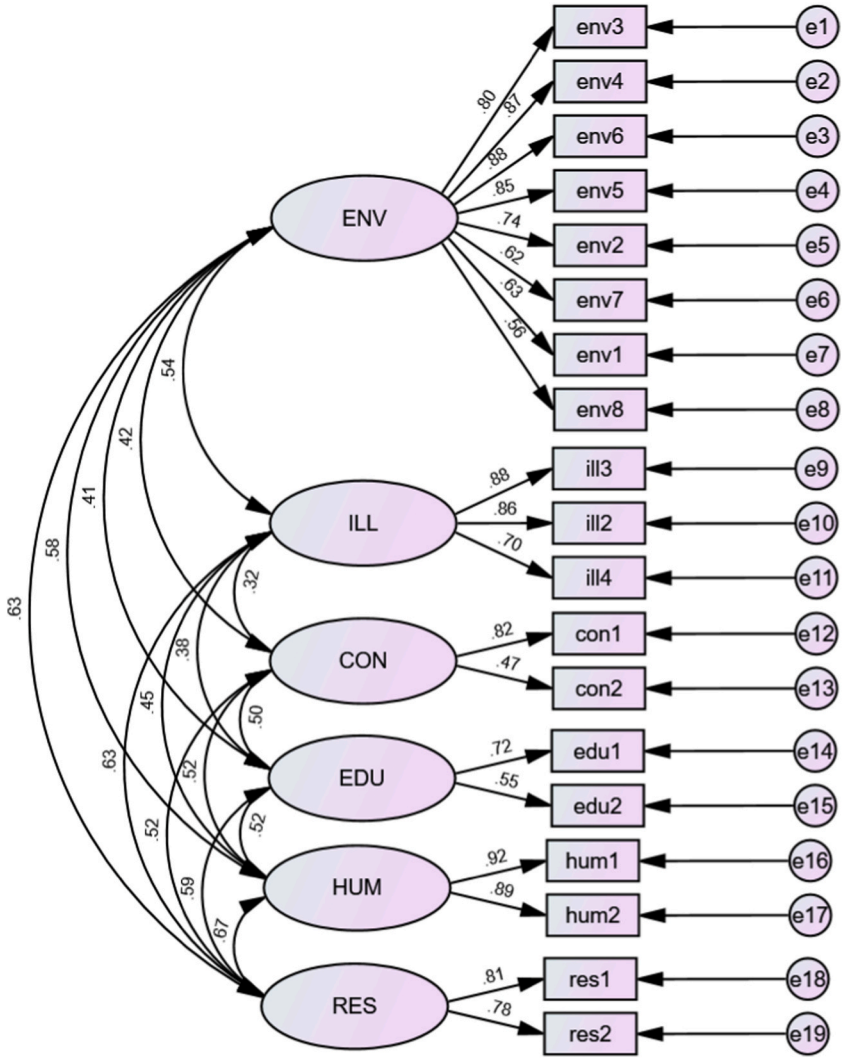

Fig. 2. Structural model: standardized path coefficient of the latent variables.

of 0.890 (for H18) and 0.918 (for H19) respectively. Lastly, resource sustainability demonstrated robust and significant correlations with decreased resource misuse (res1) and potential for sustainable resource development (res2), resulting in path coefficient estimates of 0.810 (for H9) and 0.775 (for H10) respectively.

All hypotheses postulated within the framework of the Confirmatory Factor Analysis (CFA) have been accepted and compellingly substantiated. The analysis showcased substantial relationships, as demonstrated by the calculated path coefficients, with corresponding p-values indicating statistical significance. This empirical substantiation not only underscores the veracity of the proposed model but also validates its ability to elucidate the intricate interplay among the variables under investigation. The observed significant path coefficients and associated p-values collectively affirm the coherence of the conceptual framework and its capacity to provide insights into the complex relationships among the studied variables.

Table 7 presents the covariances and correlations between the latent variables, revealing a strong positive correlation with high significance among the factors. It's worth noting that multi-comparison adjustment was not applied in this study. The correlation among the latent variables is depicted in Table 7, showing robust positive correlations. Given that the parameters in SEM models were correlated, making multiplicity adjustments overly conservative [35–37]. Table 8 displays the exogenous variables, factors, and model residuals, along with their estimated variances, indicating highly significant explanatory power.

Table 9 contains the factor loadings of the factor items. Overall factor loadings range between 0.918 and 0.472. All the items had positive loading on the factors, explaining them well, although 'con2' and 'edu2' had a loading of 0.472 and 0.550 on their respective factors, which is relatively less than the others but still explains the factors enough.

Table 6
Confirmatory factor analysis standardized estimates of path coefficients.

Variables	Path of coefficients	Latent variables	Path coefficients	*p*-value
env3	<—	ENV	.799	<0.0001
env4	<—	ENV	.873	<0.0001
env6	<—	ENV	.884	<0.0001
env5	<—	ENV	.848	<0.0001
env2	<—	ENV	.739	<0.0001
env7	<—	ENV	.616	<0.0001
env1	<—	ENV	.630	<0.0001
env8	<—	ENV	.556	<0.0001
ill3	<—	ILL	.878	<0.0001
ill2	<—	ILL	.858	<0.0001
ill4	<—	ILL	.700	<0.0001
con1	<—	CON	.816	<0.0001
con2	<—	CON	.472	<0.0001
edu1	<—	EDU	.722	<0.0001
edu2	<—	EDU	.550	<0.0001
hum1	<—	HUM	.918	<0.0001
hum2	<—	HUM	.890	<0.0001
res1	<—	RES	.810	<0.0001
res2	<—	RES	.775	<0.0001

Table 7
Covariances and correlation estimates of the latent variables.

Latent variables	Path	Latent variables	Covariance Estimate	S.E.	Critical region	*p*-value	Correlation Estimate
ENV	<→	ILL	.239	.017	14.278	<0.0001	.537
ENV	<→	CON	.162	.015	10.785	<0.0001	.418
ENV	<→	EDU	.156	.016	9.734	<0.0001	.407
ENV	<→	HUM	.284	.019	15.288	<0.0001	.578
ENV	<→	RES	.271	.018	15.073	<0.0001	.629
ILL	<→	CON	.125	.015	8.381	<0.0001	.320
ILL	<→	EDU	.147	.016	9.013	<0.0001	.379
ILL	<→	HUM	.225	.018	12.744	<0.0001	.453
ILL	<→	RES	.275	.018	15.221	<0.0001	.633
CON	<→	EDU	.169	.016	10.397	<0.0001	.502
CON	<→	HUM	.224	.017	12.985	<0.0001	.519
CON	<→	RES	.197	.016	12.046	<0.0001	.519
EDU	<→	HUM	.224	.019	11.968	<0.0001	.523
EDU	<→	RES	.222	.018	12.258	<0.0001	.593
HUM	<→	RES	.323	.020	16.167	<0.0001	.673

Discussion

Amidst the extensive disruptions caused by the pandemic, which led to widespread lockdowns in nearly every country to mitigate its spread, there emerged a glimmer of hope amid the challenges. Despite the profound negative impact inflicted by the COVID-19 pandemic, it's vital to acknowledge a positive aspect that surfaced during this arduous period. The heightened self-awareness and increased COVID-19 awareness among individuals played a pivotal role in restraining the virus's transmission and mitigating the risk of other diseases. It is essential to recognize that the pandemic was predominantly negative, but the increased awareness demonstrated a positive effect amid the adversity. Yamaguchi et al. [38] looked at the favorable aspects of COVID-19 in terms of social interaction and psychological well-being. Reduced traffic and road accidents, decreased levels of air pollution, enhanced environmental conditions, lesser crime rates, reduced expenses throughout most places, community engagement, family interaction, individual behavioral betterment, sanitary conditions, hygiene, and online and distance education were some of the positive features of the pandemic lockdown to be acknowledged [39]. During the lockdown period, there was an improvement in air quality, and a corresponding decrease in the occurrence of traffic accidents was observed [40]. In determining the positive features of the pandemic situation, our study took into account the same types of characteristics.

The study's research questions encompassed a diverse array of topics, aiming to investigate the positive impacts of the COVID-19 lockdown on various aspects of society and the environment. Regarding these research questions, the study explored the impact of the lockdown on family bonds and found evidence supporting an increase in family cohesion. Additionally, it investigated the surge in online business activities during the lockdown period, along with the implementation and effectiveness of online education and training programs. The research also examined the positive outcomes of utilizing the internet in productive ways. The study assessed whether the lockdown measures encouraged graduate and postgraduate students to engage in more research activities, which is consistent with findings from previous studies [29,31,32]. Furthermore, it explored how individual attitudes and creativity were influenced during the lockdown period and whether the lockdown led to the exploration of new income-generating opportunities for

Table 8
Variance estimation of the exogenous variables.

Exogenous variables	Estimate	S.E.	C.R.	*p*-value
ENV	.441	.027	16.625	<0.0001
ILL	.450	.025	18.225	<0.0001
CON	.341	.036	9.378	<0.0001
EDU	.334	.035	9.615	<0.0001
HUM	.549	.028	19.362	<0.0001
RES	.421	.027	15.419	<0.0001
e1	.249	.011	21.783	<0.0001
e2	.166	.009	19.297	<0.0001
e3	.147	.008	18.684	<0.0001
e4	.198	.010	20.417	<0.0001
e5	.333	.015	22.755	<0.0001
e6	.412	.017	23.762	<0.0001
e7	.477	.020	23.680	<0.0001
e8	.474	.020	24.040	<0.0001
e9	.134	.011	12.542	<0.0001
e10	.142	.010	14.275	<0.0001
e11	.301	.014	21.572	<0.0001
e12	.171	.031	5.442	<0.0001
e13	.356	.017	20.870	<0.0001
e14	.306	.029	10.544	<0.0001
e15	.464	.025	18.905	<0.0001
e16	.102	.012	8.408	<0.0001
e17	.135	.012	11.195	<0.0001
e18	.220	.015	14.406	<0.0001
e19	.239	.014	16.626	<0.0001

Cronbach's alpha is a metric for determining the internal consistency, or reliability, of a set of scale or test items. In other words, a measurement's reliability refers to how constant it is in measuring a notion, and Cronbach's alpha is one means of determining how strong that consistency is Cronbach's alpha values of the factors are presented in Table 9.

Table 9
Factor loadings and Cronbach's alpha.

Item	Variable descriptions	Factors						Cronbach Alpha
		RES	HUM	EDU	CON	ILL	ENV	
res2	Sustainable development of resources being possible	.775						0.771
res1	Misuse of resources lessen	.810						
hum2	Humanity increasing		.890					0.900
hum1	Human sympathy is growing		.918					
edu2	Graduate/Post graduate students doing more research			.550				0.569
edu1	Your creativity flourished			.722				
con2	Do you think COVID conscious help protecting it?				.472			0.556
con1	Being more conscious of yourself				.816			
ill4	Illegal products being less imported/exported					.700		0.846
ill2	Illegal drugs use lessens					.858		
ill3	People taking fewer illegal drugs					.878		
env8	Less use of public transport						.556	0.908
env1	Trees cut down less than before						.630	
env7	Environmental pollution of tourist centers decreasing						.616	
env2	Less environmental pollution						.739	
env5	Wildlife being more protected						.848	
env6	Biodiversity being conserved						.884	
env4	Increasing nature conservation						.873	
env3	Air pollution decreasing						.799	

individuals [30]. Regarding the environment, the research examined the impact of the lockdown on reducing deforestation, environmental pollution, air pollution, and promoting nature conservation, wildlife protection, and biodiversity conservation, which aligns with findings from several studies [14,15,17]. The study also assessed the impact of the lockdown on reducing environmental pollution in tourist destinations and the production of unhealthy food. Moreover, it investigated the promotion of homemade food consumption. The research explored how lockdown measures positively impacted humanitarian values, empathy, and individual patience levels. Additionally, it assessed the potential for sustainable resource development and reduction in resource misuse during the lockdown, in line with findings from previous studies [19–21]. The study also examined the impact of the lockdown on an increase in religious practices, reduction in illegal activities and drug circulation, and accidents.

The most notable outcome of the lockdown was the evident positive impact on the environment. Concurrently, illegal activities

appeared to have diminished, as crime rates dropped and the transportation of prohibited substances was reduced. It is noteworthy that self-awareness saw a substantial rise, particularly in relation to health and safety regulations. Another study shared similar observations, attributing the bluer skies, decreased car accidents, lower crime rates, and fading of contagious diseases to people's heightened health awareness during COVID-19 lockdowns [41]. Building on these perspectives, this study constructed a structural equation model to explore the positive aspects associated with the lockdown situation. The survey collected responses from participants on various aspects, including environmental improvements, personal awareness, social factors, educational and humanitarian development, reduction of illicit activities, and responsible resource utilization. The model revealed highly significant and positive associations between these variables. Factors such as reduced use of mass transportation, decreased tree cutting, minimized environmental pollution in tourist areas, improved wildlife protection, biodiversity conservation, enhanced ecological sustainability, and reduced air pollution were all found to be significantly linked to environmental development.

Numerous recent studies have highlighted significant progress in the environmental sector during the lockdown period when a majority of the world's population stayed indoors [39,40,42]. Research confirmed improvements in global environmental conditions, such as air and river water quality, with wildlife flourishing, particularly in India [15,43]. Additionally, the study's findings indicate that reduced criminal activity correlates with a decrease in the import/export of illicit products and a decline in illegal drug use, as well as a decrease in the consumption of illegal substances during the lockdown. The study also found a positive relationship between self-consciousness and COVID-19 consciousness, indicating that heightened awareness leads to better self-protection [41]. The research also revealed positive implications for education, with increased creativity and graduate/postgraduate students engaging in more research activities during the lockdown, utilizing their additional free time effectively. Studies [28,29] highlighted various positive consequences of the COVID-19 pandemic in the education industry, including blended learning, the development of learning management systems, open and distant learning (ODL), and global collaboration. According to a study, individual creativity experienced a boost during the pandemic, with people exploring various creative activities in their free time [30]. University students took advantage of their increased free time during the lockdown to undertake several research projects on diverse topics related to the COVID-19 pandemic, collaborating with national and international academicians, as reported by some studies [31,32].

Furthermore, the pandemic witnessed an increase in humanitarian efforts and human sympathy, coinciding with other research variables. The study also highlighted the positive impact of resource sustainability on reducing resource misuse and achieving resource improvement. A comprehensive model encompassing all the aforementioned aspects and factors related to the positive impact of the COVID-19 lockdown was constructed, yielding results consistent with the study's hypotheses and demonstrating a good fit with highly significant correlations between the factors and variance explanation. The study answered its research questions, demonstrating positive impacts of the COVID-19 lockdown on various aspects of society and the environment. The data analysis and findings provided insights into family bond enhancement, increased online business activities, improved efficiency in online training, reduced environmental pollution, enhanced nature conservation efforts, and more. The study's findings on the positive impacts of the COVID-19 lockdown offer valuable opportunities for future research. One area for investigation is the long-term effects of the observed positive changes during the lockdown period, providing insights into their sustainability and lasting impact on individuals' behaviors and attitudes. Comparative analysis among different regions or countries can unveil variations in positive outcomes, informing effective measures for future pandemics. Exploring the enhancement of support systems for mental health and well-being can also be beneficial. Additionally, identifying specific conservation strategies implemented during lockdowns can lead to measures for preserving natural environments and biodiversity. Understanding the socioeconomic impacts of the lockdown and identifying gaps in response mechanisms can contribute to better preparation for future crises. Future research can also focus on developing evidence-based policy recommendations that promote societal well-being and environmental conservation during challenging times. Overall, conducting studies in these areas can foster a comprehensive understanding of the positive outcomes during lockdowns and improve preparedness for similar situations in the future.

Limitations

This study has some limitations to address. The study only covered development from a social and economic standpoint, collecting information on individuals, families, and coherent social groups as well as information on the environment and its effects on biodiversity. But a more thorough approach based on the triple bottom line and taking into account more proven and useful methodological difficulties would also provide a more thorough understanding of the relationship of the latent variables of the study. Amid the COVID-19 outbreak, reaching a significant number of volunteers became highly challenging, necessitating a countrywide lockdown and stringent regulations. Following the resolution of the COVID-19 situation, the same procedure is suggested for future use when incorporating additional frameworks to monitor outcomes during the recovery phase. Only the quantitative elements of the interest evaluation variable were examined in this study. To address the issues that the quantitative analysis does not address, we recommend integrating a more in-depth qualitative inquiry in future studies.

Conclusion

The COVID-19 epidemic swiftly spread globally, leading to a dire pandemic with profound health consequences. In reaction, governments enforced lockdown measures, causing significant challenges for different societal groups, such as wage earners, students, and employees. However, amidst these predominantly negative effects, a glimmer of positivity emerged through heightened self-consciousness and increased COVID-19 awareness, playing a pivotal role in curbing the virus's spread. The study aimed to shed light on some of the positive impacts of the COVID-19 lockdown. To investigate these impacts, a semi-structured questionnaire was

developed using Google Forms, encompassing specific variables. A diverse population of 1230 respondents from Bangladesh participated, primarily engaging through social media platforms. Throughout the COVID-19 lockdown, individuals engaged in creative pursuits and exhibited heightened awareness of the virus, which also extended to an increased awareness of other diseases. Noteworthy shifts occurred during this phase, with some adopted practices potentially carrying forward beyond the pandemic's resolution. The research meticulously identified relevant variables through a questionnaire survey to evaluate the positive effects of the COVID-19 lockdown. While these findings are insightful, there may be additional changes that were not explored in this study. Further research in this field is imperative to gain comprehensive insights and aspire to lead a sustainable life even in such challenging circumstances.

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Informed consent

Each participant consented willingly during the interview period.

Data availability statement

Data will be made available on request.

CRediT authorship contribution statement

MdGalib Ishraq Emran: Conceptualization, Methodology, Investigation, Formal analysis, Data curation, Writing – original draft, Writing – review & editing, Validation. **Khandaker Tanveer Ahmed:** Conceptualization, Methodology, Investigation, Formal analysis, Data curation, Writing – original draft, Writing – review & editing, Validation. **Al-Shahriar Khan:** Conceptualization, Investigation, Data curation, Writing – original draft, Writing – review & editing, Validation. **Labiba Rahman:** Investigation, Data curation, Writing – original draft, Writing – review & editing, Validation. **Mehedi Hasan Momin:** Conceptualization, Investigation, Writing – original draft, Writing – review & editing, Validation. **Apurba Kumar Das:** Investigation, Writing – original draft, Writing – review & editing, Validation. **Sadia Akter:** Investigation, Data curation, Writing – review & editing, Validation. **Manika Saha:** Investigation, Writing – review & editing, Validation. **Sanchita Banerjee:** Writing – review & editing, Validation. **Tania Ahmed Tonni:** Writing – review & editing, Validation. **A.F.M. Mahmudul Islam:** Supervision, Conceptualization, Investigation, Writing – review & editing, Validation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix ASupplementary data

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